

International Application No.: PCT/JP03/16838

U.S. Patent Application No.: Unknown

September 28, 2004

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## REMARKS

Claims 42-89 are pending in this application. By this Preliminary Amendment, Applicants amend the specification, the abstract of the disclosure, cancel claims 1-41 and add new claims 42-89.

Applicants have attached hereto a Substitute Specification in order to make corrections of minor informalities contained in the originally filed specification. Applicant's undersigned representative hereby declares and states that the Substitute Specification filed concurrently herewith does not add any new matter whatsoever to the above-identified patent application. Accordingly, entry and consideration of the Substitute Specification are respectfully requested.

The changes to the specification have been made to correct minor informalities to facilitate examination of the present application.

Applicants respectfully submit that this application is in condition for allowance. Favorable consideration and prompt allowance are respectfully solicited.

Respectfully submitted,



Date: September 28, 2004

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10/509369

DT12 Rec'd PCT/PTO 28 SEP 2004

**MARKED-UP VERSION OF  
SUBSTITUTE SPECIFICATION**

**DESCRIPTION**Attorney Docket No. 90606.24

DECORATIVE SHEET, MOLDED ARTICLE, MOTOR VEHICLE, AND  
PRODUCTION METHOD OF MOLDED ARTICLE

5 **TECHNICAL FIELD****BACKGROUND OF THE INVENTION**1. **Field of the Invention**

The present invention relates to a molded article, which is decorated, and a production method thereof. The present invention also 10 relates to a decorative sheet used for decorating such a molded article, and a motor vehicle provided with such a molded article.

**BACKGROUND ART2. Description of the Related Art**

Recently, as a technique for decorating various kinds of molded 15 articles, a technique for attaching a decorative sheet onto a surface of a molded article ~~is~~has been proposed. The decorative sheet used in this technique is disclosed in Japanese Laid-Open Patent Publication No.10-249999, for example.

\_\_\_\_ The decorative sheet disclosed in the above-identified publication includes a base member and an ink layer formed-provided on a surface of the base member by printing. The decorative sheet is attached to a molded article with an adhesive. When such a decorative sheet is used,

5 the molded article can be easily recycled as compared with the case of paint application using a coating material. In addition, such a decorative sheet ~~can-create-creates~~ creates a beautiful appearance which is different from the paint application, ~~so-such~~ such that ~~a-the~~ the decorative quality ~~can-be-is~~ improved.

10 \_\_\_\_ A conventional decorative sheet is, however, suitable for the decoration of a molded article having a flat surface, but is not suitable for the decoration of a molded article having an uneven surface. When such a decorative sheet is attached to a molded article having an uneven surface, the decorative sheet is spread so as to follow the unevenness.

15 Therefore, if a pattern of a character, a graphic symbol, a picture, ~~and~~ the-like-or other decoration is represented in ~~part-a~~ part-a portion of the decorative sheet, the pattern is deformed, and the decorative appearance is ~~uglified~~ deteriorated.

~~The present invention has been conducted in view of the above-~~

## SUMMARY OF THE INVENTION

To overcome the problems described problems, and the object above, preferred embodiments of the present invention is to provide a decorative sheet preferably used for the decoration of a molded 5 article having an uneven surface, a molded article to which the decorative sheet is attached, a production method thereof, and a motor vehicle provided with such a molded article.

## DISCLOSURE OF INVENTION

10 The A decorative sheet according to a preferred embodiment of the present invention includes: a base member, formed from made of a resin material, and having a first and a second principal surfaces opposite that are opposed to each other; a decoration layer, provided on the first principal surface of the base member, and having a pattern area 15 representing a predetermined pattern; and a spread suppressing member, provided in at a position location corresponding to the pattern area on the side of the first principal surface or on the side of the second principal surface of the base member, for suppressing the spreading of the pattern area of the decoration layer, thereby attaining the above-mentioned

object.

\_\_\_\_ In one preferred embodiment, the resin material is a thermoplastic resin material.

5       \_\_\_\_ In one—another preferred embodiment, the spread suppressing member has a higher coefficient of thermal conductivity than a coefficient of thermal conductivity of the base member.

10      \_\_\_\_ In one—another preferred embodiment, the spread suppressing member is ~~formed from~~made of a material including metal or a metal compound.

15      \_\_\_\_ In one—another preferred embodiment, the spread suppressing member is ~~formed~~made of metal.

\_\_\_\_ In one preferred embodiment, a coefficient of thermal conductivity of the spread suppressing member is about 10 W/m—K or more.

15      \_\_\_\_ Preferably, a thickness of the spread suppressing member is ~~5  $\mu$  m or more and 100  $\mu$  m or less~~in the range of about 5  $\mu$ m to about 100 $\mu$ m.

\_\_\_\_ Preferably, the spread suppressing member includes a first portion

which overlaps the pattern area.

More preferably, the spread suppressing member includes a second portion ~~positioned~~ disposed in an outer circumference of the first portion.

5       Preferably, a width of the second portion of the spread suppressing member is in the range of about 1 mm ~~or more and to about~~ 10 mm ~~or less~~.

More preferably, a width of the second portion of the spread suppressing member is in the range of about 2 mm ~~or more and to about~~ 10 mm ~~or less~~.

10       The molded article according to another preferred embodiment of the present invention includes a molded article body and the decorative sheet ~~with~~having the above-described structure, which is joined to a surface of the molded article body, ~~thereby attaining the above-~~ 15 ~~mentioned object~~.

15       In another aspect~~preferred embodiment of the present invention~~, the molded article ~~according to the present invention~~ includes a molded

article body; and a sheet joined to a surface of the molded article body, wherein the sheet includes a base member and a decoration layer provided on a surface of the base member on the side of the molded article body, the decoration layer has a pattern area representing a 5 predetermined pattern, and a portion of the sheet corresponding to the pattern area has a thickness ~~which that is in the range of about~~ 1.1 times ~~or more and to about~~ 1.8 times ~~or less as large as~~ a thickness of the other portion of the sheet, ~~thereby attaining the above-mentioned object.~~

Preferably, the portion of the sheet corresponding to the pattern 10 area has a thickness ~~which is that is in the range of about~~ 1.2 times ~~or more and to about~~ 1.6 times ~~or less as large as~~ the thickness of the other portion of the sheet.

~~The A~~ motor vehicle according to another preferred embodiment of the present invention includes the molded article having the above- 15 described structure, ~~thereby attaining the above-mentioned object.~~

~~The A~~ production method of a molded article according to another preferred embodiment of the present invention includes the steps of: preparing a decorative sheet including: a base member, ~~formed from~~

made of a resin material; and having a—first and a—second principal surfaces oppositethat are opposed to each other;—, a decoration layer, provided on the first principal surface of the base member;— and having a pattern area representing a predetermined pattern;—, and a spread 5 suppressing member; provided inat a positionlocation corresponding to the pattern area on the side of the first principal surface or on the side of the second principal surface of the base member, for suppressing the spreading of the pattern area of the decoration layer;—, preparing a molded article body;—, and joining the decorative sheet to a surface of the 10 molded article body, ~~thereby attaining the above-mentioned object.~~

\_\_\_\_ In oneanother preferred embodiment of the present invention, the production method of a molded article according to the present invention includes, before the step of joining the decorative sheet to the surface of the molded article body, the step of heating the decorative 15 sheet.

\_\_\_\_ In oneanother preferred embodiment, the resin material is a thermoplastic resin material.

\_\_\_\_ In oneanother preferred embodiment, the spread suppressing

member has a higher coefficient of thermal conductivity than a coefficient of thermal conductivity of the base member.

135       In oneanother preferred embodiment, the spread suppressing member is ~~formed form~~made of a material including metal or a metal 5 compound.

145       In oneanother preferred embodiment, the spread suppressing member is ~~formed~~made of metal.

155       In oneanother preferred embodiment, the coefficient of thermal conductivity of the spread suppressing member is about 10 W/m—K or 10 more.

165       Preferably, a thickness of the spread suppressing member is ~~5  $\mu$ m~~  
~~or more and 100  $\mu$ m or less~~in the range of about 5 $\mu$ m to about 100 $\mu$ m.

175       Preferably, the spread suppressing member has a first portion which overlaps the pattern area.

185       More preferably, the spread suppressing member includes a second portion ~~positioned~~disposed in an outer circumference of the first portion.

\_\_\_\_ Preferably, a width of the second portion of the spread suppressing member is in the range of about 1 mm or more and to about 10 mm or less.

\_\_\_\_ More preferably, a width of the second portion of the spread 5 suppressing member is in the range of about 2 mm or more and to about 8 mm or less.

\_\_\_\_ In oneanother preferred embodiment, the step of joining the decorative sheet to the surface of the molded article body includes the step of moving the heated decorative sheet closer to the molded article 10 body, and the step of reducing a pressure of a first space formed between the decorative sheet ~~coming~~that is closer to the molded article body and the molded article body as compared with a pressure of a second space ~~expanded oppositely to~~that is greater than the first space with respect to the decorative sheet.

15 \_\_\_\_ In oneanother preferred embodiment, the step of moving the decorative sheet closer to the molded article body is performed ~~in~~such a manner that the spread suppressing member faces the second space.

\_\_\_\_ In oneanother preferred embodiment, ~~in~~ the production method of a

molded article according to the present invention includes, after the step of moving the decorative sheet closer to the molded body, the step of cooling the spread suppressing member by introducing a gas into the second space.

5       In oneanother preferred embodiment, the production method of a molded article according to the present invention includes, after the step of joining the decorative sheet to the surface of the molded body, the step of removing the spread suppressing member.

      In oneanother preferred embodiment, the spread suppressing member is provided on the side of the second principal surface of the base member.

      In oneanother preferred embodiment, after the step of joining the decorative sheet to the surface of the molded article body, the decoration layer is positioned disposed between the base member and the 15 molded article body.

      In oneanother preferred embodiment, the molded article body includes a first member and a second member disposed on a surface of the first member, and in the step of joining the decorative sheet to the

surface of the molded article body, the decorative sheet is joined to the surface of the molded article body so as to cover both of the first member and the second member, thereby joining the first member and the second member.

5 ~~In another aspect, the~~ The production method of a molded article according to another preferred embodiment of the present invention includes the steps of: preparing a decorative sheet including a base member, ~~formed from a~~ made of a resin material, and having a first and a second principal surfaces ~~opposite~~opposed to each other, and a

10 decoration layer, provided on the first principal surface of the base member, and having a pattern area representing a predetermined pattern; preparing a molded article body; heating the decorative sheet; and joining the decorative sheet, which ~~is~~has been heated, to a surface of the molded article body ~~in a condition where~~such that a temperature

15 of a portion of the decorative sheet corresponding to the pattern area is ~~lower~~less than a temperature of the other portion of the decorative sheet, ~~thereby attaining the above-mentioned object.~~

In one~~another~~ preferred embodiment, the step of joining the decorative sheet to the surface of the molded article body includes the

step of cooling the decorative sheet ~~in~~ such a manner that the temperature of the portion corresponding to the pattern area is rapidly ~~lowered~~ reduced as compared with the temperature of the other portion.

5       \_\_\_\_ In oneanother preferred embodiment, the decorative sheet further includes a member, provided ~~that~~ a positionlocation corresponding to

the pattern area on the side of the first principal surface or on the side of the second principal surface of the base member, and having a higher coefficient of thermal conductivity than a coefficient of thermal conductivity of the base member.

10      \_\_\_\_ In oneanother preferred embodiment, the member is ~~formed from a~~ made of a material including metal.

\_\_\_\_ In oneanother preferred embodiment, the member is ~~formed~~made of metal.

15      \_\_\_\_ In oneanother preferred embodiment, a coefficient of thermal conductivity of the member is about 1.0 W/m~~—~~ K or more.

The A motor vehicle according to another preferred embodiment of the present invention includes the molded article produced by the above-

described production method, thereby attaining the above-mentioned object.

Other features, elements, steps, characteristics and advantages will

5 become more apparent from the following detailed description of  
preferred embodiments of the present invention with reference to the  
attached drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1(a) is a sectional view schematically showing a decorative sheet according to a preferred embodiment of the present invention, and FIG. 1(b) is a top view schematically showing the decorative sheet 5 according to a preferred embodiment of the present invention.

FIGS. 2(a) and (b) are views showing exemplary patterns represented by a pattern area of a decoration layer.

FIG. 3 is a sectional view schematically showing another preferred embodiment of a decorative sheet according to the present invention.

10 FIGS. 4(a), (b), and (c) are views schematically showing one preferred embodiment of the use of the decorative sheet according to the present invention.

FIG. 5 is a view schematically showing a preferred structure of a spread suppressing member.

15 FIGS. 6(a) and (b) are views schematically showing another preferred embodiment in which the decorative sheet according to the present invention is joined to a molded article body.

FIGS. 7(a) and (b) are views schematically showing another preferred embodiment in which the decorative sheet according to the present invention is joined to a molded article.

FIG. 8 is a sectional view schematically showing a producing apparatus used for producing a molded article with the decorative sheet according to a preferred embodiment of the present invention.

FIG. 9 is a process sectional view schematically showing a production method of a molded article with the decorative sheet according to a preferred embodiment of the present invention.

FIG. 10 is a process sectional view schematically showing a production method of a molded article with the decorative sheet according to a preferred embodiment of the present invention.

FIG. 11 is a process sectional view schematically showing a production method of a molded article with the decorative sheet according to a preferred embodiment of the present invention.

FIG. 12 is a process sectional view schematically showing a production method of a molded article with the decorative sheet

according to a preferred embodiment of the present invention.

FIG. 13 is a process sectional view schematically showing a production method of a molded article with the decorative sheet according to a preferred embodiment of the present invention.

5 FIG. 14 is a process sectional view schematically showing a production method of a molded article with the decorative sheet according to a preferred embodiment of the present invention.

FIG. 15 is a time chart showing an exemplary time required for a production process.

10 FIG. 16 is a sectional view schematically showing a molded article.

FIG. 17 is a sectional view schematically showing a molded article.

FIG. 18(a) and (b) are sectional views schematically showing a condition where a decorative sheet is joined to a molded article body having a plurality of members which are separately molded.

15 FIG. 19 is a view schematically showing a two-wheeled vehicle.

**BEST MODE FOR CARRYING OUT THE INVENTIONDETAILED**

**DESCRIPTION OF PREFERRED EMBODIMENTS**

\_\_\_\_ Hereinafter preferred embodiments of the present invention will be described with reference to the accompanying drawings. The present 5 invention is not limited to the preferred embodiments described below.

\_\_\_\_ A decorative sheet 10 in this preferred embodiment is schematically shown in FIGS. 1(a) and (b). The decorative sheet 10 includes, as shown in FIGS. 1(a) and (b), a base member 1 having a first principal surface 1a and a second principal surface 1b which are 10 oppositeopposed to each other, and a decoration layer 2 provided on the first principal surface 1a of the base member 1.

\_\_\_\_ The base member 1 is formed frommade of a resin material, and typically formed frompreferably of a thermoplastic resin material. The decoration layer 2 is preferably formed from ink, or the like. The 15 decoration layer 2 includes a pattern area 2a representing a predetermined pattern. The pattern represented by the pattern area 2a is concretely preferably a design such as a diagram, a color-coding, or gradation, and more concretely particularly, a character shown in FIG. 2(a), a graphic symbol shown in FIG. 2(b), or a picture.

\_\_\_\_ In FIGS. 1(a) and (b) ~~show a case where~~, the decoration layer 2 having the pattern area 2a ~~in~~along an entire surface thereof is provided on parta portion of the principal surface 1a. Alternatively, as shown in FIG. 3, the decoration layer 2 having the pattern area 2a only in parta 5 portion may be provided on the entire surface of the principal surface 1a. An area 2b other than the pattern area 2a of the decoration layer 2 is, for example, a monotone area without any pattern, ~~for example~~.

\_\_\_\_ FIGS. 4(a), (b), and (c) show examples of the use of the decorative sheet 10. The decorative sheet 10 is joined to the surface of a molded 10 article body 21, so as to decorate the molded article 20, as shown in FIGS. 4(a), (b), and (c). The decoration layer 2 has a pattern area 2a, ~~so such that high improved~~ decorating effects can be attained~~are achieved~~, as compared ~~with to~~ a decoration layer having no pattern ~~as a whole~~, for example. 15 In other words, the pattern area 2a is an area ~~of~~in which improved decoration accuracy ~~as decoration~~ is ~~more highly required than as~~ compared to the other area of the decoration layer 2 after the joining~~being joined~~ to the molded article body 21.

\_\_\_\_ The molded article body 21 shown in FIG. 4(a) has a protruding

portion 21a of a substantially hemispherical shape (e.g., a bowl-like shape), and the surface is uneven. Therefore, when the decorative sheet 10 is to be joined, the decorative sheet 10 is spread so as to follow the unevenness. In order to preferably successfully perform the spread of 5 the decorative sheet 10, ~~typically, the joining is~~ preferably performed after the decorative sheet 10 is heated and softened.

The decorative sheet 10 according to the present invention is provided with a spread suppressing member 3 for suppressing the spread of the pattern area 2a, as shown in FIGS. 1(a) and (b), and FIG. 3. The 10 spread suppressing member 3 is provided ~~in a position at a location~~ corresponding to the pattern area 2a. The spread suppressing member 3 in this preferred embodiment is provided arranged so as to overlap the pattern area 2a on the side of the second principal surface 1b of the base member 1 (on the side opposite to the side on which the decoration layer 15 2 is provided).

The spread suppressing member 3 is has a ~~member with lower~~ spreading property than that of the base member 1, for example, so such that the spread of the pattern region 2a is suppressed.

\_\_\_\_ Alternatively, the spread suppressing member 3 has a ~~higher~~ higher coefficient of thermal conductivity that is greater than a coefficient of thermal conductivity of the base member 1, ~~so such~~ that the spread of the pattern area 2a is suppressed. If the coefficient of thermal conductivity 5 of the spread suppressing member 3 is ~~higher~~ greater than the coefficient of thermal conductivity of the base member 1, a temperature of a portion of the decorative sheet 10 on which the spread suppressing member 3 is provided ~~lowers~~ reduces more rapidly than the other portion after the heating. Thus, the spreading property is ~~lowered~~ reduced as compared 10 with to the other portion. Therefore, the spreading of the pattern area 2a is suppressed.

~~It is understood that the~~ The spread suppressing member 3 preferably has both of the above-described ~~two~~ physical properties, in order to effectively suppress the spread of the pattern region 2a.

15 \_\_\_\_ If the joining as shown in FIGS. 4(a) and ~~(b)~~ to (c) is performed by using a conventional decorative sheet, the pattern such as a character, a graphic symbol, or a picture is deformed, ~~so such~~ that the ~~beautiful~~ appearance of the molded article is ~~uglified~~ deteriorated.

\_\_\_\_ On the contrary, the decorative sheet 10 according to preferred embodiments of the present invention includes the spread suppressing member 3, so such that the spread of the pattern region 2a in joining to the molded article body 21 can be is suppressed. Therefore, when the 5 decoration of the molded article is performed by using the decorative sheet 10 according to preferred embodiments of the present invention, the deformation of the pattern can be is prevented, and beautiful the appearance can be attainedof the pattern is greatly improved. The spread suppressing member 3 is providedarranged so as to overlap only 10 parta portion of the principal surface 1b of the base member 1 in accordance with the pattern area 2a (that is, provided partially with respect to on the principal surface of the base member 1), so such that the following property of the decorative sheet 10 for closely follows the unevenness of the surface of the molded article body 21 is hardly 15 degraded.

\_\_\_\_ Hereinafter, preferable materials, structures, and layouts of the spread suppressing member 3, the decoration layer 2, and the base member 3-1 will be described.

\_\_\_\_ As a material for the spread suppressing member 3, metal such as

aluminum, copper, and stainless steel can be preferably used. As the spread suppressing member 3, a foil, a film, a thin plate, or ~~the like~~  
~~formed~~other suitable spread suppressing member made of any one of the above-mentioned metals may be preferably used. Generally, a 5 coefficient of thermal conductivity of metal is ~~higher~~greater than a coefficient of thermal conductivity of a resin by two or three digits. For this reason, if metal is used as the material for the spread suppressing member 3, the coefficient of thermal conductivity of the spread suppressing member 3 ~~can be sufficiently higher~~is substantially greater 10 than the coefficient of thermal conductivity of the base member 1 ~~formed from~~made of a resin material. Therefore, it is easy to rapidly ~~lower~~reduce the temperature of the portion of the decorative sheet 10 in which the spread suppressing member 3 is provided. Thus, ~~it is possible to effectively suppress~~ the spread of the pattern area 2a is effectively 15 suppressed.

\_\_\_\_The spread suppressing member 3 is not limited to ~~that formed~~being made of metal. Since metal or a metal compound has a much higher coefficient of thermal conductivity than that of a resin, the coefficient of thermal conductivity of the spread suppressing member 3

~~can be higher will be sufficiently greater than the coefficient of thermal conductivity of the base member 1 by using a material including metal or a metal compound. As a material including metal or a metal compound, for example, a material in which filler (inorganic filler) ~~formed from~~~~

5 ~~including~~ metal or a metal compound is ~~dispersedly~~ mixed in a resin matrix ~~is listed~~may be used. As a metal compound ~~which constitutes of~~ the ~~filler~~, for example, a metal oxide such as alumina ~~can~~may be used.

\_\_\_\_ In order to rapidly ~~lower~~reduce the temperature of the portion of the decorative sheet 10 in which the spread suppressing member 3 is provided, and to effectively suppress the spread of the pattern region 2a, the coefficient of thermal conductivity of the spread suppressing member 3 is preferably ~~equal to or in the range of about~~ 50 times, ~~and more~~ preferably ~~equal to or about~~ 100 times ~~as compared with that of~~ the coefficient of thermal conductivity of the base member 1. Specifically, 15 the coefficient of thermal conductivity of the spread suppressing member 3 is preferably about 10 W/m—K or more, ~~more preferably and more~~ preferably about 15 W/m—K or more, and much more preferably about 20 W/m—K. The coefficient of thermal conductivity of a resin material is about 0.2 (the coefficient of thermal conductivity of polycarbonate is

0.19 W/m—K, and the coefficient of thermal conductivity of acryl resin is 0.2 W/m—K, for example). On the contrary, the coefficient of thermal conductivity of alumina is about 21 W/m—K, and the coefficient of thermal conductivity of aluminum is about 236 W/m—K.

5       Alternatively, as the material for the spread suppressing member 3, a resin material ~~can~~may be used. If a resin material having a higher deflection temperature under load (a heat deflection temperature) than that of a resin material ~~which forms~~of the base member 1, or a resin material having higher rigidity than that of a resin material ~~which forms~~  
10    of the base member 1, is used, the spreading property of the spread suppressing member 3 ~~can be lower~~is less than that of the base member 1, ~~so such~~ that the spread of the pattern region 2a ~~can be~~is suppressed.

      A thickness of the spread suppressing member 3 is preferably 5  $\mu$ m or more and 100  $\mu$ m or less. in the range of about 5  $\mu$ m to about 15    100  $\mu$ m. If the thickness is ~~lower~~less than about 5  $\mu$ m, the strength is ~~failed~~insufficient, and deformation or breakage may occur. If the thickness exceeds about 100  $\mu$ m, in the case where metal is used as the material, the following property of the spread suppressing member 3 with respect to the unevenness (convex and concave) of the molded

article body 21 is sometimes insufficient. Thus, there is a fear that the spread suppressing member 3 may be peeled off induring joining.

As shown in FIG. 5, the spread suppressing member 3 preferably has a portion 3a which overlaps the pattern area 2a (an overlap portion) 3a. When the spread suppressing member 3 has includes such an overlap portion 3a, the effect for suppressing the spread can be is directly attained achieved for the pattern area 2a. Thus, the spreading of the pattern area 2a can be is effectively suppressed.

As shown in the figure FIG. 5, when the spread suppressing member 3 also has includes a portion 3b which is positioned disposed in an outer circumference of the overlap portion 3a (an outer circumference portion) 3b, the spreading of the pattern area 2a can be is more surely suppressed. From the point of view that the spreading of the pattern area 2a is effectively suppressed, and the spreading of the portion other than the pattern area 2a is not prevented, the width of the outer circumference portion 3b of the spread suppressing member 3 is preferably in the range of about 1 mm or more and to about 10 mm or less, and more preferably in the range of about 2 mm or more and to about 8 mm or less.

Even if the spread suppressing member 3 does not include a portion overlapping the pattern area 2a, but has a frame-like shape fringing along the edges of the pattern area 2a, the spreading of the pattern area 2a ~~can be~~ is suppressed. However, as shown in FIG. 5, ~~the case where~~ when the 5 spread suppressing member 3 ~~has~~ includes the portion 3a overlapping the pattern area 2a ~~can attain higher effect for suppressing, the spread~~ suppressing member 3 suppresses the spreading of the pattern area 2a more effectively.

As a material of the decoration layer 2, ink including a resin 10 material as a binder and pigment dispersed in the resin material can be used, ~~for as an~~ example. The decoration layer 2 can be formed by printing with such an ink, for example. The material of the decoration layer 2 is preferably superior in heat resistance and flexibility. The ink disclosed in Japanese Laid-Open Patent Publication No.2002-275405 has 15 superior heat resistance and flexibility, ~~so such~~ that the ink ~~can be~~ is preferably used as the material for the decoration layer 2.

As a resin material ~~which forms of~~ the base member 1, a thermoplastic resin material can be suitably used, as described above. More specifically, polycarbonate (PC), acrylic resin, polyethylene

terephthalate (PET), urethane resin, or ~~the like other suitable resin material~~ can be preferably used. However, since the base member 1 is ~~required to~~~~must~~ have rigidity as a sheet base member, it is preferred that a resin material be selected in consideration of this ~~point~~rigidity.

5 Although a thermosetting resin material can be used as the resin material ~~which forms of~~ the base member 1, it is preferred that a thermoplastic resin material be used in view of the formability of the decorative sheet 10.

\_\_\_\_\_A thickness of the base member 1 is preferably within the range of 10 about 100 µm or more and to about 1000-µm or less. If the thickness of the base member 1 is less than about 100-µm, it is difficult to handle the base member as a sheet, or there may occur a ~~disadvantageous easeproblem~~ where the strength is not sufficient and breakage occurs in joining. If the thickness of the base member 1 exceeds about 1000-µm, 15 the following property with respect to the surface of the molded article body 21 may be deteriorated.

\_\_\_\_\_The joining of the decorative sheet 10 may be performed, as shown in FIG. 6(a), ~~in such a manner that~~ the first principal surface 1a on which the decoration layer 2 is provided faces the molded article body

21, or alternatively as shown in FIG. 6(b), ~~in such a manner that the~~ the second principal surface **1b** on the opposite side to the first principal surface **1a** faces the molded article body **21**.

\_\_\_\_\_The spread suppressing member **3** may be provided, as shown in FIGS. 6(a) and (b), on the side of the second principal surface **1b** of the base member **1** (the side on which the decoration layer **2** is not provided), or alternatively provided, as shown in FIGS. 7(a) and (b), on the side of the first principal surface **1a** of the base member **1** (the side on which the decoration layer **2** is provided). In the case where the spread suppressing member **3** is provided on the side of the first principal surface **1a**, after the decoration layer **2** is formed on the spread suppressing member **3** by printing or other meansprocesses, the accumulated body may be provided on the first principal surface **1a** of the base member **1**. Alternatively, the spread suppressing member **3** may be provided on both sides of the first principal surface **1a** and the second principal surface **1b** of the base member **1**.

\_\_\_\_\_As shown in FIG. 6(a) and FIG. 7(a), when the joining is performed ~~in such a manner that the first principal surface **1a** on which the decoration layer **2** is provided faces the molded article body **21**, the~~

decoration layer 2 is positionedarranged between the base member 1 and the molded article body 21 in the completed molded article, sosuch that the decoration layer 2 ~~can be~~is advantageously protected by the base member 1.

5       On the other hand, as shown in FIG. 6(b) and FIG. 7(b), when the joining is performed ~~in~~such ~~a~~manner that the second principal surface 1b faces the molded article body 21, the decoration layer 2 is positionedarranged on the outer side than the base member 1. Therefore, there is an advantage that in addition to a transparent resin material or a  
10    translucent resin material, an opaque resin material can be preferably used as the resin material for ~~forming~~ the base member 1.

      As shown in FIG. 6(a) and FIG. 7(b), when the joining is performed ~~in~~such ~~a~~manner that the spread suppressing member 3 is positionedarranged on the side ~~opposite~~ side to the molded article body  
15    21 with respect to the base member 1, it is possible to remove the spread suppressing member 3 after the joining. ~~It is possible to prevent the~~  
      beautiful ~~The~~ appearance is prevented from being deteriorated because the spread suppressing member 3 remains in the completed molded article. In addition, ~~it is possible to neglect the contribution of the~~

~~spread suppressing member 3 to the spread suppressing member 3 is not a portion of the decoration in the completed molded article, so such that the material for the spread suppressing member 3 can be more freely selected (it is unnecessary to use a transparent or translucent material, for example). Thus, it is possible to preferably use various materials such as metal can be used.~~

Especially when the spread suppressing member 3 is provided on the side of the second principal surface 1b of the base member 1 (on the side opposite to the side on which the decoration layer 2 is provided), and the joining is performed in such a manner that the first principal surface 1a on which the decoration layer 2 is provided faces the molded article body 21, as shown in FIG. 6(a), both of the advantages that the decoration layer 2 can be is protected by the base member 1 and that it is possible to remove the spread suppressing member 3. Thus, large merits in practical use can be attained. are achieved.

For the fixing of the spread suppressing member 3 and the decorative sheet 10, an adhesive is preferably used, for example. As an adhesive, a thermoplastic resin (thermoplastic polyurethane resin or thermoplastic acrylic resin) can may be used, or a thermosetting resin (an

epoxy resin, for example) ~~can~~may be used. When the decorative sheet 10 is heated before the joining, the adhesive preferably has high heat resistance. ~~In the ease where~~Where the spread suppressing member 3 is removed after the joining, ~~it is preferred that~~ the adhesive used for 5 joining the spread suppressing member 3 ~~be easily peeled~~is preferably easy to peel off. As an adhesive which has high heat resistance and which can be easily peeled off, an adhesive of silicone type is ~~listed~~ specifically preferable.

Next, a production method of a molded article using the decorative 10 sheet 10 and a production apparatus used in the production method will be described.

First, a production apparatus 100 for the molded article is described with reference to FIG. 8. The production apparatus 100 includes, as shown in FIG. 8, a holding device (a holding frame) 30 for 15 holding the decorative sheet 10, a supporting device (a supporting table) 31 for supporting the molded article body 21, a pressurizing box 32 ~~positioned~~arranged above the holding device 30 and the supporting device 31, a sealing cylinder 33 for moving ~~up and down~~ the pressurizing box 32 up and down, a pressurizing rubber hose 34 for

introducing a gas into a space below the pressurizing box 32, a heater (a far infrared heater, for example) 35 for heating the decorative sheet 10, and a vacuum vessel 36 for accommodating ~~them~~the components of the production apparatus 100.

5       The vacuum vessel 36 includes a first vessel 36a for accommodating the holding device 30, the supporting device 31, the box 32, the cylinder 33, and the rubber hose 34, and a second vessel 36b for accommodating the heater 35. The heater 35 may be introduced into the first vessel 36a via a door 37, if required.

10       The supporting device 31 has a plurality of openings 31a. With a vacuum pump which is externally provided, the atmospheric air is sucked through the openings 31a, thereby realizing a reduced pressure (evacuation) of the space spreading over the supporting device 31. The rubber hose 34 is connected to the outside. By introducing a gas through 15 the rubber hose 34, the space spreading below the box 32 can be pressurized.

      Next, with reference to FIGS. 9 to 15, a production method of a molded article utilizing the decorative sheet 10 will be described. FIGS.

9 to 14 are process sectional views schematically showing the production method of the molded article. FIG. 15 is a time chart showing an example of periods of time required for respective steps.

\_\_\_\_ First, the decorative sheet 10 such as shown in FIG. 1 is prepared.

5 The decorative sheet 10 can be prepared from the above-described materials by known techniques. For example, the decorative sheet 10 can be prepared in such a manner that a decoration layer 2 is formed by printing with ink on a first principal surface 1a of a base member 1, and a spread suppressing member 3 is fixed with an adhesive on the side of a

10 second principal surface 1b of the base member 1.

\_\_\_\_ In a separate step from the step of preparing the decorative sheet 10, a molded article body 21 is prepared. The molded article body 21 may be formed from a resin material, or may be formed from a metal material. Alternatively, the molded article body 21 may be formed from

15 ~~the other materials (formed of, such as~~ wood, for example). The molded article body 21 may be transparent, opaque, or translucent. The molded article body 21 ~~can be~~ is preferably prepared by a known technique. ~~In the case where~~ Where a resin material is used, the molded article body 21 ~~can~~ may be prepared by injection molding, for example. As the resin

material, both of a thermoplastic resin and a thermosetting resin can be used. Specifically, an unsaturated polyester resin, an epoxy resin, a vinyl ester resin, a polyurethane resin, and ~~the like and another suitable resins may be used.~~

5 Next, as shown in FIG. 9, the molded article body 21 is placed on the supporting device 31, and the decorative sheet 10 is fixed to the holding device 30 ~~so such~~ that the decorative sheet 10 is ~~positioned~~arranged above the molded article body 21. At this time, an adhesive is applied to a surface of the decorative sheet 10 on the side of 10 the molded article body 21. In this preferred embodiment, thereafter, the air in the vacuum vessel 3536 is sucked through the openings 31a of the supporting device 31 by ~~means of the~~a vacuum pump which is externally provided. Thus, the pressure in the inside of the vacuum vessel 3536 is ~~preliminarily~~reduced. As the result of the pressure reduction, the 15 internal pressure of the vacuum vessel 3536 is preferably about 2.7 kPa or less, for example.

Next, as shown in FIG. 10, the decorative sheet 10 is heated by ~~means of the~~ heater 35, thereby softening the decorative sheet 10. At this time, the decorative sheet 10 is typically heated ~~up~~ to temperatures

equal to or ~~higher~~greater than a deflection temperature under load of the resin material which forms the base member 1. If the heating temperature is too low, it is difficult to deform the resin material. Therefore, the resin material may be broken ~~in shaping~~ (in 5 ~~attaching~~when being shaped (or attached), or the shaping itself cannot be performed. If the heating temperature is too high, ~~sags of the sheet in heating~~ ~~remarkably occur, setends to sag when heated, such that it is~~ difficult to perform the shaping, or the appearance may be degraded because of air bubbles in the resin material. Therefore, it is preferred 10 that the heating temperature be appropriately set in accordance with the ~~kind~~type of the resin material ~~of used~~ for the base member 1. When polycarbonate is used as the resin material for ~~forming~~ the base member 1, the decorative sheet 10 is heated up to about  $195^{\circ}\text{C}$ , for example. The movement of the heater 35 from the second vessel 36b to the first 15 vessel 36a is performed in about 3 to about 5 seconds, for example. The heating by the heater 35 is performed for about 15 to about 30 seconds, for example.

Thereafter, as shown in FIG. 11, the pressurizing box 32 and the holding device 30 are moved downwardly by the ~~cylinder~~cylinders 33,

~~so such that the decorative sheet 10 comes is moved~~ closer to the molded article body 21. The downward movement is performed in about 1 to about 2 seconds, for example. In this preferred embodiment, the decorative sheet 10 is moved downwardly. Alternatively, the supporting 5 device 31 for supporting the molded article body 21 may be moved upwardly, ~~so such that the decorative sheet 10 comes closer to the molded~~ article body 21 is moved closer to the decorative sheet 10.

\_\_\_\_ Next, as shown in FIG. 12, a pressure of a first space formed between the decorative sheet 10 and the molded article body 21 is more 10 reduced more than a pressure of a second space expanded on the opposite side to the first space with respect to the decorative sheet 10 (that is, a space formed between the decorative sheet 10 and the pressurizing box 32). As a result, the decorative sheet 10 is joined to the molded article body 21, as shown in FIG. 13.

15 \_\_\_\_ Specifically, together with the reduction of pressure in the first space by ~~means of the~~ vacuum pump, a gas is introduced into the box 32 through the rubber hose 34, so as to pressurize the second space. As a result, the decorative sheet 10 is pressed against the molded article body 21 with a substantially uniform pressure, thereby joining the decorative

sheet 10 to the molded article body 21. The pressure ~~reduction~~is reduced in the first space ~~is performed, so such~~ that the internal pressure of the first space is about 2.7 kPa or less, for example. The pressurizing of the second space is performed, ~~so such~~ that the internal pressure of the 5 second space is about 0.2 MPa to about 0.5 MPa. The reduced pressure condition of the first space and the pressurized condition of the second space are ~~retained~~maintained for a predetermined period of time (for at least about 15 seconds-or more, for example). A temperature of the gas (the air, for example) introduced into the second space is about ~~a~~-room 10 temperature (about 15°C to about 30°C), for example.

Next, the vacuum vessel 3536 is opened, ~~so such~~ that the internal pressure of the vacuum vessel 3536 is returned to be the atmospheric pressure. Unnecessary portions of the decorative sheet 10 are cut (trimmed) with a cutting meansdevice, such as a rotary blade. 15 Thereafter, the molded article body 21 is released from the supporting device 30, thereby completing a molded article 20, as shown in FIG. 14.

According to the above-described production method, ~~it is possible to perform~~ the joining of the decorative sheet 10 to the molded article body 21 (~~that is, the figuration of the decorative sheet 10~~) performed in

a very short period of time (in about 1 second or less, as exemplarily described). In addition, in during joining, the decorative sheet 10 is entirely completely spread, but the spreading of the pattern portion 2a of the decoration layer 2 is suppressed by means of the spread 5 suppressing member 3. Therefore, the distortion of the pattern is prevented, and the beauty in appearance is not deteriorated.

When the spreading property of the spread suppressing member 3 is poorer less than the spreading property of the base member 1, the spreading of the pattern portion 2a is suppressed for this reason. When 10 the coefficient of thermal conductivity of the spread suppressing member 3 is higher greater than the coefficient of thermal conductivity of the base member 1, the temperature of the portion of the decorative sheet 10 in which the spread suppressing member 3 is provided (that is, the portion corresponding to the pattern area 2a) more rapidly 15 lowers decreases than the temperature of the other portion portions of the decorative sheet 10. Therefore, the joining of the decorative sheet 10 is performed in a condition wherein which the temperature of the portion of the decorative sheet 10 corresponding to the pattern area 2a is lower less than the temperature of the other portion portions of the decorative sheet

10. Therefore, the spreading of the pattern portion 2a is further suppressed.

When the heating by the heater 35 is stopped, the decorative sheet 10 is allowed to naturally cooled (~~allowed to cool~~). As a result, the 5 above-described non-uniform temperature distribution of the decorative sheet 10 ~~can be realized~~is achieved. Alternatively, ~~more~~ positive cooling may be performed. When the gas is introduced into the second space ~~in~~during joining, as in this preferred embodiment, the introduced gas can not only pressurize the second space, but also cool the surface of 10 the decorative sheet 10 on the side of the second space. Therefore, when the spread suppressing member 3 faces the second space, the spread suppressing member 3 is cooled by the gas, ~~so~~such that the above-described non-uniform temperature distribution ~~can be~~is rapidly ~~realized~~achieved. Therefore, even ~~in the case~~ where the joining is 15 performed in a very short time as described above, the spreading of the pattern area 2a ~~can be more surely~~is more effectively suppressed.

~~In the case where~~ Where the joining is performed ~~so~~such that the spread suppressing member 3 faces the second space, the spread suppressing member 3 may be removed from the molded article 20, if necessary. If

the fixing of the spread suppressing member 3 is performed ~~by means of~~  
using ~~an adhesive which~~~~that~~ can be easily peeled off, the removal can  
be ~~preferably~~ easily performed.

~~It is not necessarily that the~~ The spread suppressing member 3 is  
5 ~~directly in~~not required to be in direct contact with the first principal  
surface 1a or the second principal surface 1b of the base member 1.  
The An adhesive layer is typically ~~exists~~ provided between the base  
member 1 and the spread suppressing member 3, and additionally,  
another layer may be interposed. FIG. 16 is a partially enlarged view  
10 of an example of the sectional structure after the joining.

In the structure ~~exemplarily~~ shown in FIG. 16, on the second  
principal surface 1b of the base member 1 ~~formed from~~of polycarbonate,  
a protecting layer 8 preferably made of an acrylic resin is  
~~formed~~provided. On the protecting layer 8, the spread suppressing  
15 member 3 ~~formed~~preferably made of aluminum is provided with the  
adhesive layer 9 interposed therebetween. The protecting layer 8 is  
~~positioned~~arranged on the outer side ~~than~~of the base member 1 in the  
molded article 20, ~~so~~such that the protecting layer 8 protects the base  
member 1 and improves the weather resistance of the decorative sheet

10. The base member 1 has a thickness of about 200  $\mu\text{m}$  to about 1000  $\mu\text{m}$ , for example. The protecting layer 8 has a thickness of about 5  $\mu\text{m}$  to about 50  $\mu\text{m}$ , for example. The spread suppressing member 3 has a thickness of about 5  $\mu\text{m}$  to about 100  $\mu\text{m}$ , for example. The adhesive layer 9 has a thickness of about 5  $\mu\text{m}$  to about 50  $\mu\text{m}$ , for example.

As shown in FIG. 16, on the first principal surface 1a of the base member 1, the decoration layer 2 ~~formed~~preferably made of ink is provided. On the decoration layer 2, a metal layer 6 ~~formed from~~preferably made of tin is provided with the adhesive layer 7 interposed therebetween. Since the metal layer 6 has metallic luster, the decorative sheet 10 ~~can exhibit colors of~~has metallic tones (metallic color) having a metallic appearance. Herein, the metal layer 6 is formed in such a manner that tin is evaporated on a carrier film 5, and the layered body is attached to the first principal surface 1a with an adhesive. The decoration layer 2 has a thickness of about 5  $\mu\text{m}$  to about 50  $\mu\text{m}$ , for example. The metal layer 6 has a thickness of about 0.25  $\mu\text{m}$  to about 0.8  $\mu\text{m}$ , for example, and is ~~formed from~~preferably made of soft metal such as tin.

The decorative sheet 10 shown in FIG. 16 is joined to the molded

article body 21 by means of the adhesive layer 4. The adhesive layer 4 has a thickness of about 5  $\mu\text{m}$  to about 50  $\mu\text{m}$ , for example. As described above, the spread suppressing member 3 may be provided on the side of the first principal surface 1a of the base member 1. More 5 specifically, as shown by a dotdotted line in FIG. 16, on the first principal surface 1a of the base member 1, the spread suppressing member 3 may be provided with the decoration layer 2, the adhesive layer 7, the metal layer 6, and the carrier film 5 interposed therebetween.

\_\_\_\_ In order to maintain the decorating effect of the pattern area 2a of 10 the decoration layer 2 ~~high~~, as shown in FIG. 17, the thickness  $T_1$  of the portion of the sheet 10 corresponding to the pattern area 2a is preferably in the range of about 1.1 times ~~or more and to about~~ 1.8 times ~~or less as large as the greater than the~~ thickness  $T_2$  of the other portion of the sheet 10. More preferably, the thickness  $T_1$  is in the range of about 1.2 times 15 ~~or more and to about~~ 1.6 time ~~or less as large as times greater than the~~ thickness  $T_2$ . When the pattern area 2a is ~~such thin that the has a~~ thickness  $T_1$  is ~~less than about~~ 1.1 times ~~as large as the thickness  $T_2$ , stepped eutcuts~~ may occur in the pattern area 2a due to the unevenness of the surface of the molded article body 21, and desired decorating

effects ~~cannot be attained~~~~are not achieved~~. When the thickness  $T_1$  is ~~more~~~~greater~~ than about 1.8 times ~~as large as~~ the thickness  $T_2$ , the appearance of the pattern area **2a** may be distorted due to the lens effect, or the portion corresponding to the pattern area **2a** (the portion is raised 5 as compared with the other portion) may get scratched by friction.

       In ~~this~~this preferred embodiment, the molded article body **21** which is integrally formed (in other words, which has a single member) is shown. Alternatively, a molded article may have a plurality of members which are separately molded, and the plurality of members may be 10 mutually coupled by the ~~joining of the~~ decorative sheet **10**.

       Specifically, as shown in FIG. 18(a), on a surface of a molded article body **22** having a first member **22a** and a second member **22b** disposed on a surface of the first member **22a**, the decorative sheet **10** is joined so as to cover both of the first member **22a** and the second 15 member **22b**. As a result, as shown in FIG. 18(b), a molded article **20'** in which the first member **22a** and the second member **22b** are coupled ~~can be~~is obtained.

       A relative positional relationship between the first member **22a** and

the second member 22b can be arbitrarily selected. For this reason, when the plurality of members 22a and 22b of the molded article body 22 are coupled by ~~means of the joining of~~ the decorative sheet 10, as described above, a large variety of shapes of molded articles can be 5 obtained by using a relatively small number of molding dies. Therefore, the production of ~~the~~a large variety of shapes of molded articles ~~can~~ ~~be~~is easily performed at a low cost. For the first member 22a and the second member 22b, a structure for temporarily tacking them, that is, a positioning structure for determining the relative positional relationship 10 ~~can~~may be provided. The positioning structure may be a ~~protrusion~~protruding portion and a concave portion which are mutually engaged, for example.

\_\_\_\_The molded article produced by the production method using the decorative sheet 10 is suitably used for ~~the~~ interior or exterior of motor vehicles, exterior of home electric appliances, and ~~the~~ like many other 15 suitable molded articles. For example, the molded article is suitably used as a tank cover 51, a front fender 52, and a tail cowl 53 of a motorbike 50 shown in FIG. 19. As ~~we all~~is well known, ~~the~~a "motor vehicles" ~~widely indicate loco mobile conveyances or machines~~

includes any locomotive conveyance or machine for transporting passengers or merchandises, or for moving things, and ~~include~~includes a car, a ~~motorbikemotorcycle~~, a bus, a truck, a tractor, an airplane, a motorboat, a civil engineering vehicle, and ~~the like~~many other motor 5 vehicles. The motor vehicles include not only those provided with an internal combustion engine, such as a gasoline engine, but also those provided with an electric motor.

#### INDUSTRIAL APPLICABILITY

10 According to preferred embodiments of the decorative sheet of the present invention, since the spread suppressing member for suppressing the spreading of the pattern area is provided in a positionlocation corresponding to the pattern area of the decoration layer, the spreading of the pattern area in the joiningwhen joined to the molded article body

15 can beis suppressed. Accordingly, the decorative sheet according to preferred embodiments of the present invention can beis preferably used for the ~~decoration of a~~decorating ~~article of~~articles which ~~the~~have an uneven surface~~has unevenness~~. When the production of the molded article is performed by using the decorative sheet according to preferred

embodiments of the present invention, distortion of the pattern can beis  
prevented, and the appearance of the obtained molded article has  
beautiful appearaneeis greatly improved.

\_\_\_\_\_The molded article which is produced by using the decorative sheet  
5 according to preferred embodiments of the present invention is  
preferably used for various goods, and especially preferably used for the  
interior and exterior of a motor vehicle.

## **CLAIMS**

The present invention is not limited to the above-described preferred embodiments, but can be modified in the scope of the attached claims. Further, the technologies disclosed in the above-described 5 preferred embodiments can be used in combination, as desired.